

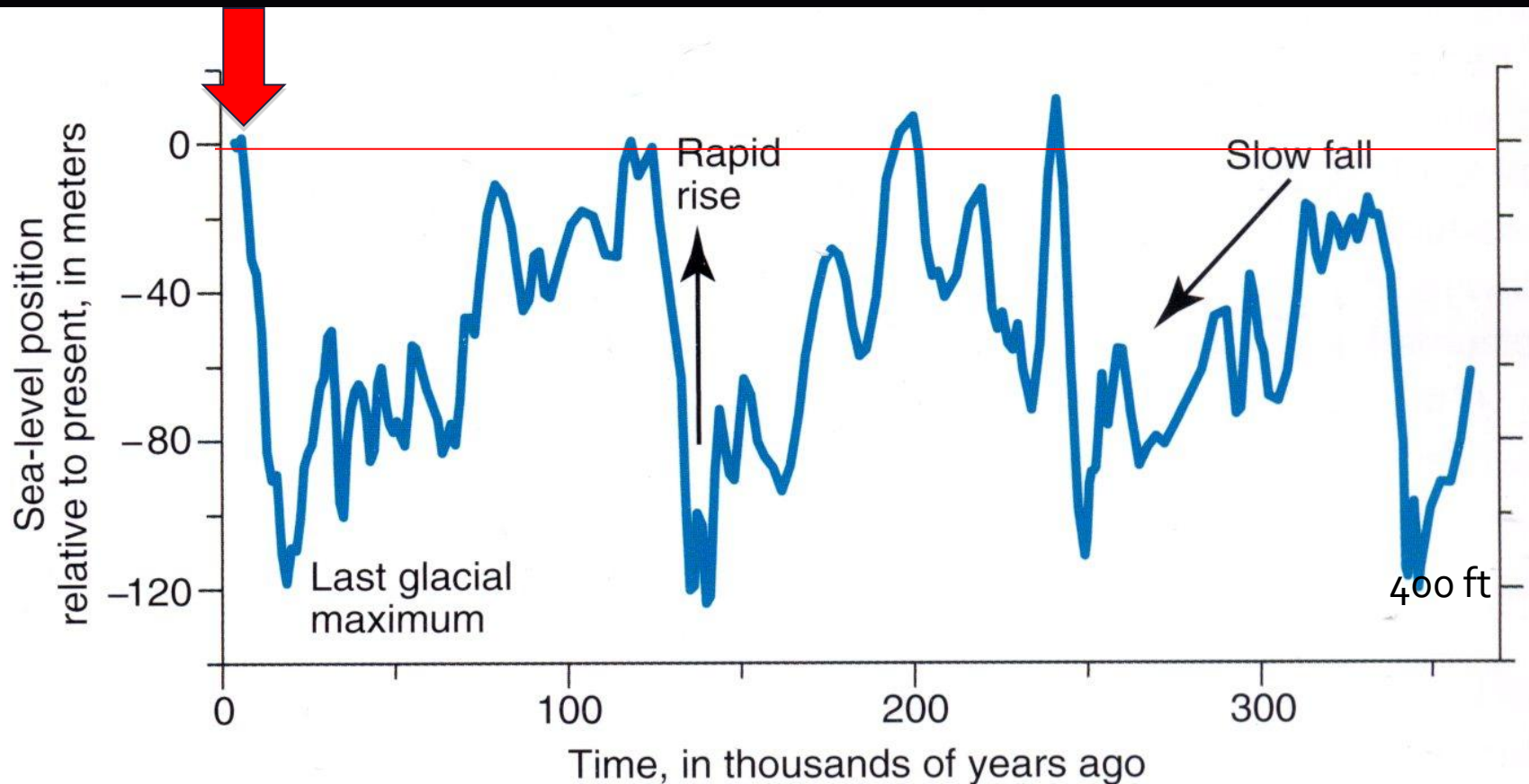
SEA-LEVEL RISE AND CALIFORNIA: IMPACTS AND ADAPTATION

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University of California Santa Cruz



Photo by: Joel Avila
Hawkeye Photography
408-260-0895

In response to Earth's orbital variations and distance from the Sun, Earth and its oceans have cooled and warmed, glaciers and ice sheets have advanced and retreated, and sea level has risen and fallen.



How has the shoreline of
California changed as sea level
has risen?



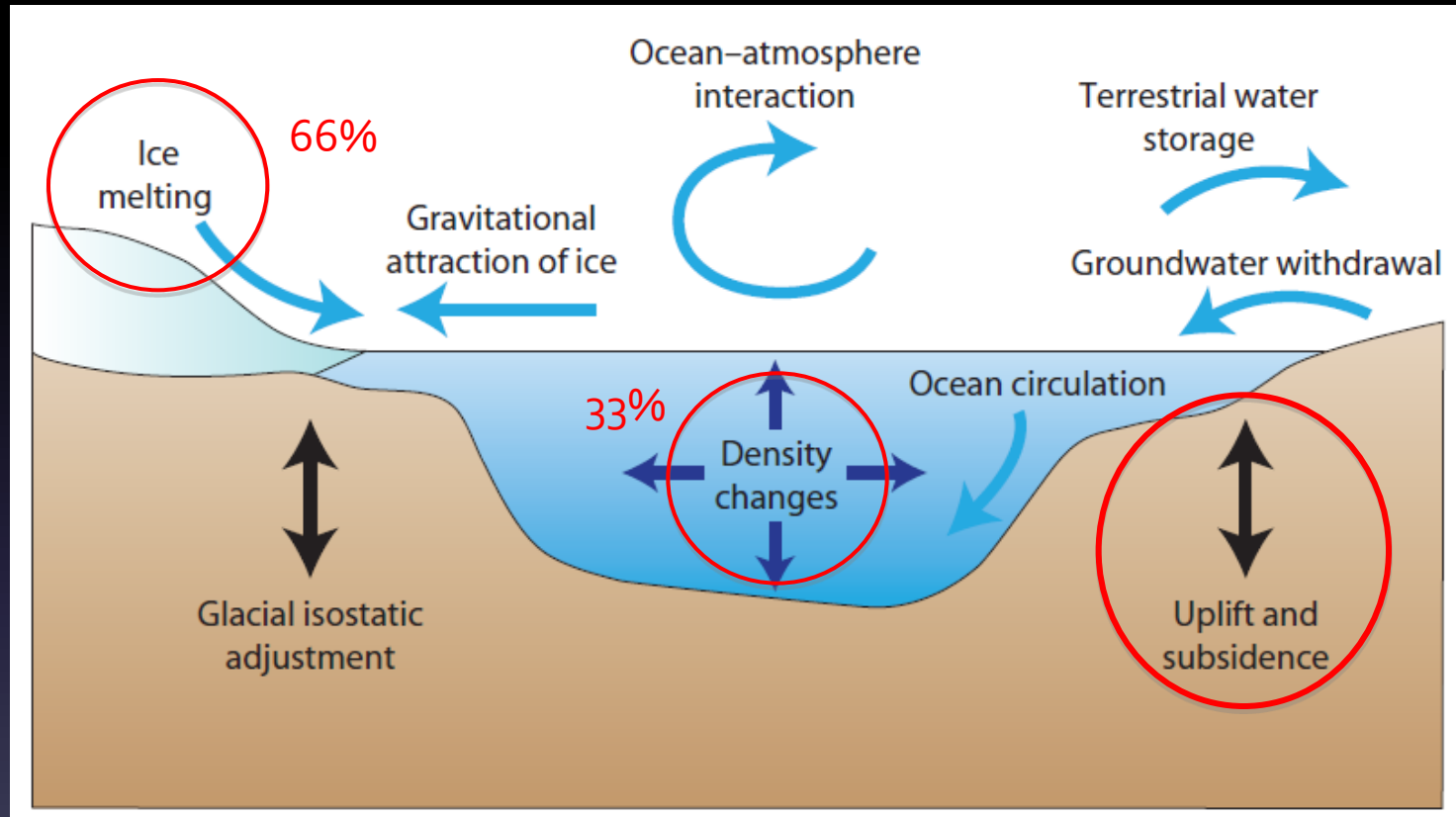
Sacramento

San Francisco

SFO

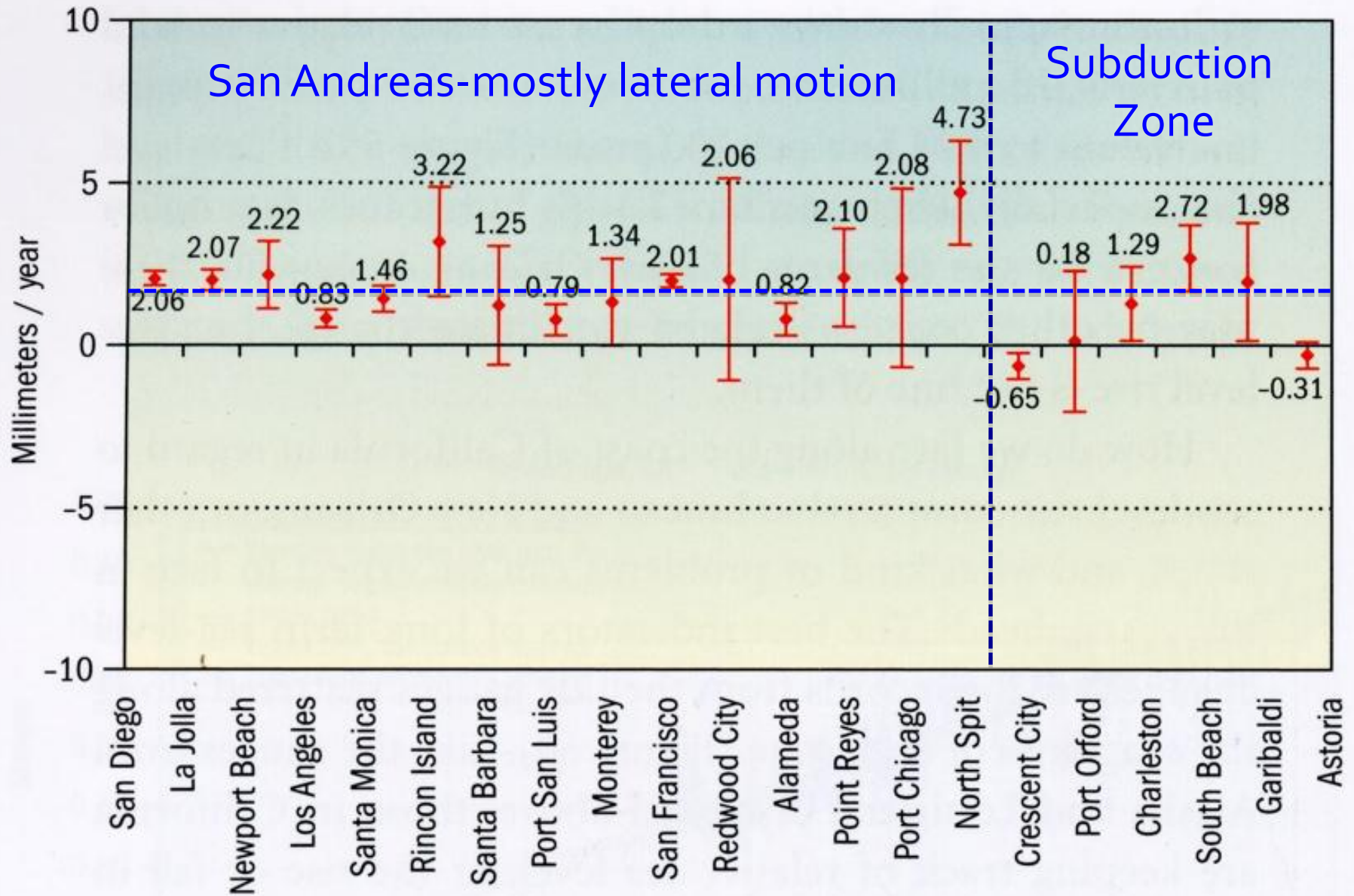
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Components of Global and Regional Sea-Level Rise



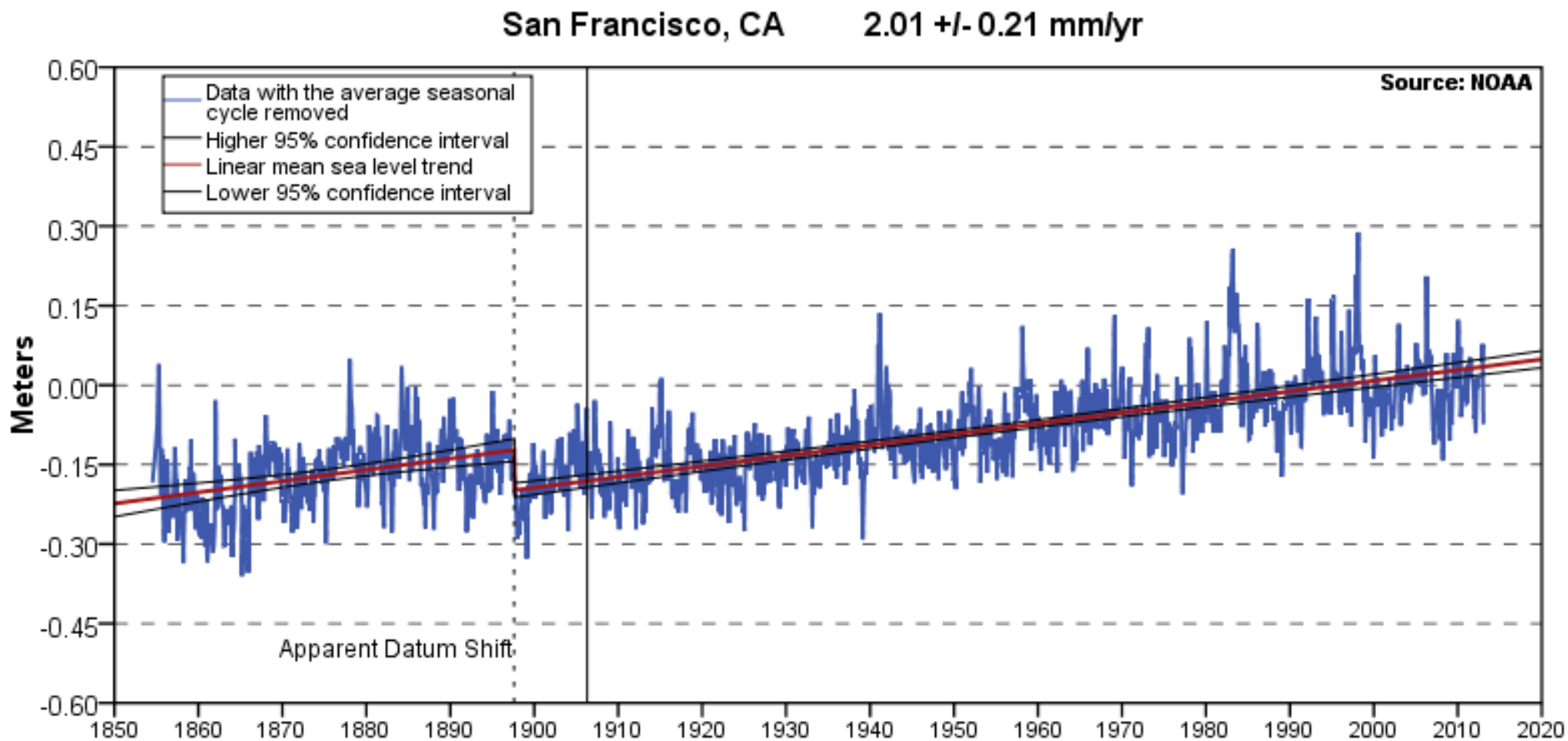
Sea-level rise at a particular place can be higher or lower than the global mean due to regional effects

Sea-level rise values vary regionally along the West Coast.



SAN FRANCISCO TIDE GAGE

2mm/yr = 8 inches/100 years



IMPACTS OF CONTINUING SEA-LEVEL RISE

1. Temporary flooding and then permanent inundation of low-lying coastal areas, including beaches
2. Continuing retreat of coastal cliffs, bluffs and dunes
3. Damage and/or loss of coastal infrastructure
4. Increased salt water intrusion
5. Potential loss of wetlands

SEA-LEVEL RISE CAN IMPACT:

1. **Existing and Proposed development**
2. **Public and Private Property and Resources.**

Public: Streets and highways; sewage treatment plants, pump stations and transmission lines; coastal power plants; railways and airports; parks and parking lots; beaches.

Private: Homes and hotels; restaurants and commercial buildings; mobile home parks and other oceanfront development.

FLOODING AND INUNDATION



Newport/Balboa High Tide December 2012

Sausalito/Mill Valley





The Embarcadero
San Francisco



Huntington Beach

PASSIVE EROSION AND BEACH LOSS WHERE POSITION OF SHORELINE IS FIXED

Former Fort Ord, Monterey Bay



BEACH CAN BE RECLAIMED WHERE BARRIERS ARE REMOVED



MONTEREY BEACH HOTEL- PASSIVE EROSION



One-third of entire coast of
southern California now armored

Large or Extreme Coastal Storms

- Most historic coastal damage from confluence of large waves, storm surges, and high tides during a strong El Niño
- 1982-83 El Niño caused more than \$200 M in damage to California
- Water levels during these events can exceed sea-level rise projections for 2030 and possibly 2050
- Their additive effects will become more significant in the future



Short-Term Impacts of High Tides and Large Storm Waves

Mission Beach, San Diego- 1988



Seacliff State Beach



SEAWALL DESTROYED FOR THE 8TH TIME
TWO MONTHS AFTER BEING REBUILT



COASTAL CLIFF AND BLUFF RETREAT

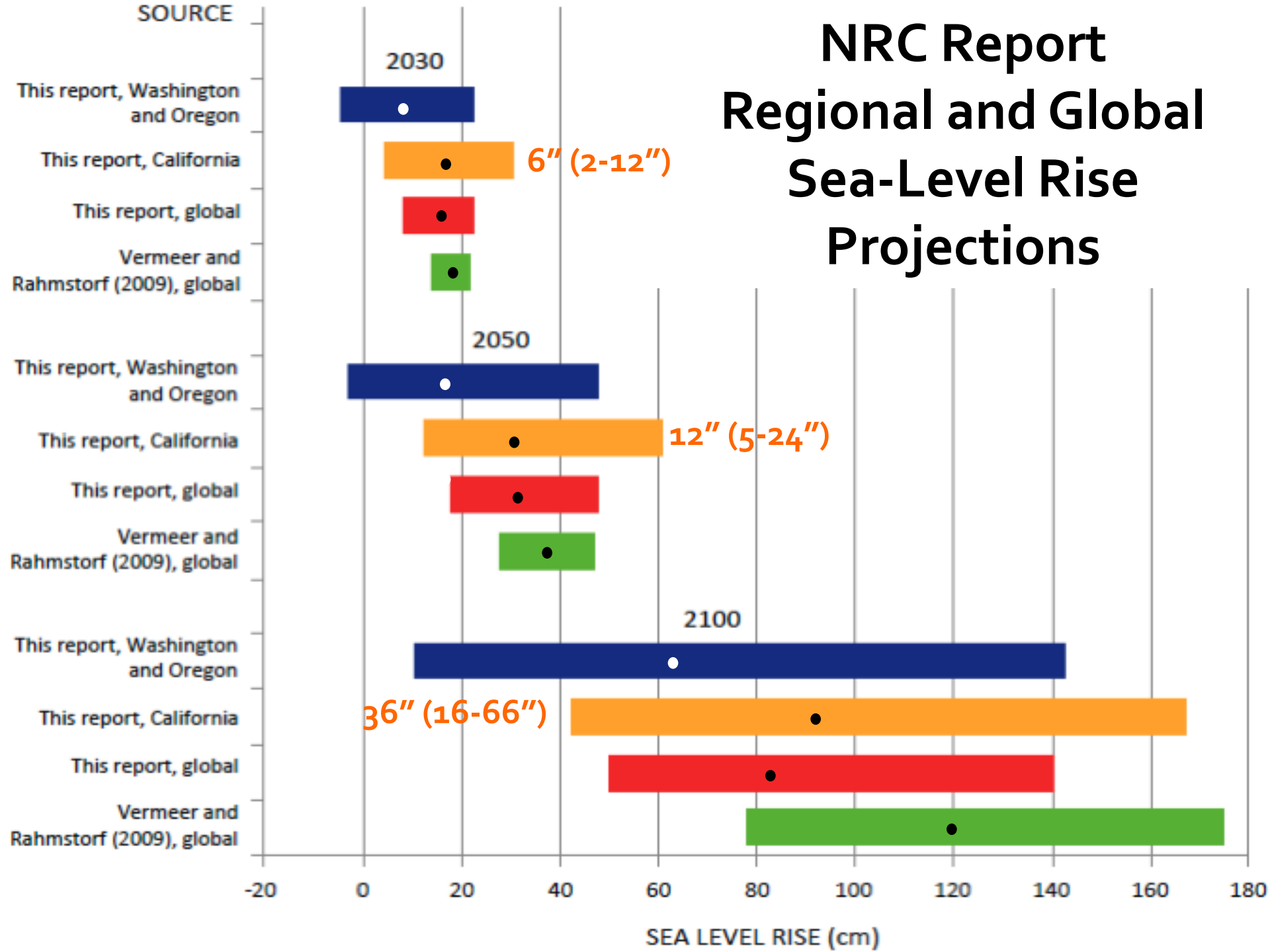


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NRC Report Regional and Global Sea-Level Rise Projections



Uncertainty



“There are the known knowns, there are the known unknowns, and there are the unknown unknowns”.

2030

Height in Inches

84

72

60

48

36

24

12

0



2050

Height in Inches

84

72

60

48

36

24

12

0



2100

Height in Inches

84

72

60

48

36

24

12

0



16-INCH SEA LEVEL RISE BY MID-CENTURY CENTRAL BAY WEST SHORE



**San Francisco
International
Airport
with a 16 inch rise
in sea level.**



SOURCE: Inundation data from Knowles, 2008. Additional salt pond elevation data by Siegel and Bachand, 2002. Aerial imagery is NAIP 2005 data.

DISCLAIMER: Inundation data does not account for existing shoreline protection or wave activity. These maps are for informational purposes only. Users, by their use, agree to hold harmless and blameless the State of California and its representatives and its agents for any liability associated with its use in any form. The maps and data shall not be used to assess actual coastal hazards, insurance requirements, or property values or be used in lieu of Flood Insurance Rate Maps issued by the Federal Emergency Management Agency (FEMA).

San Francisco International Airport

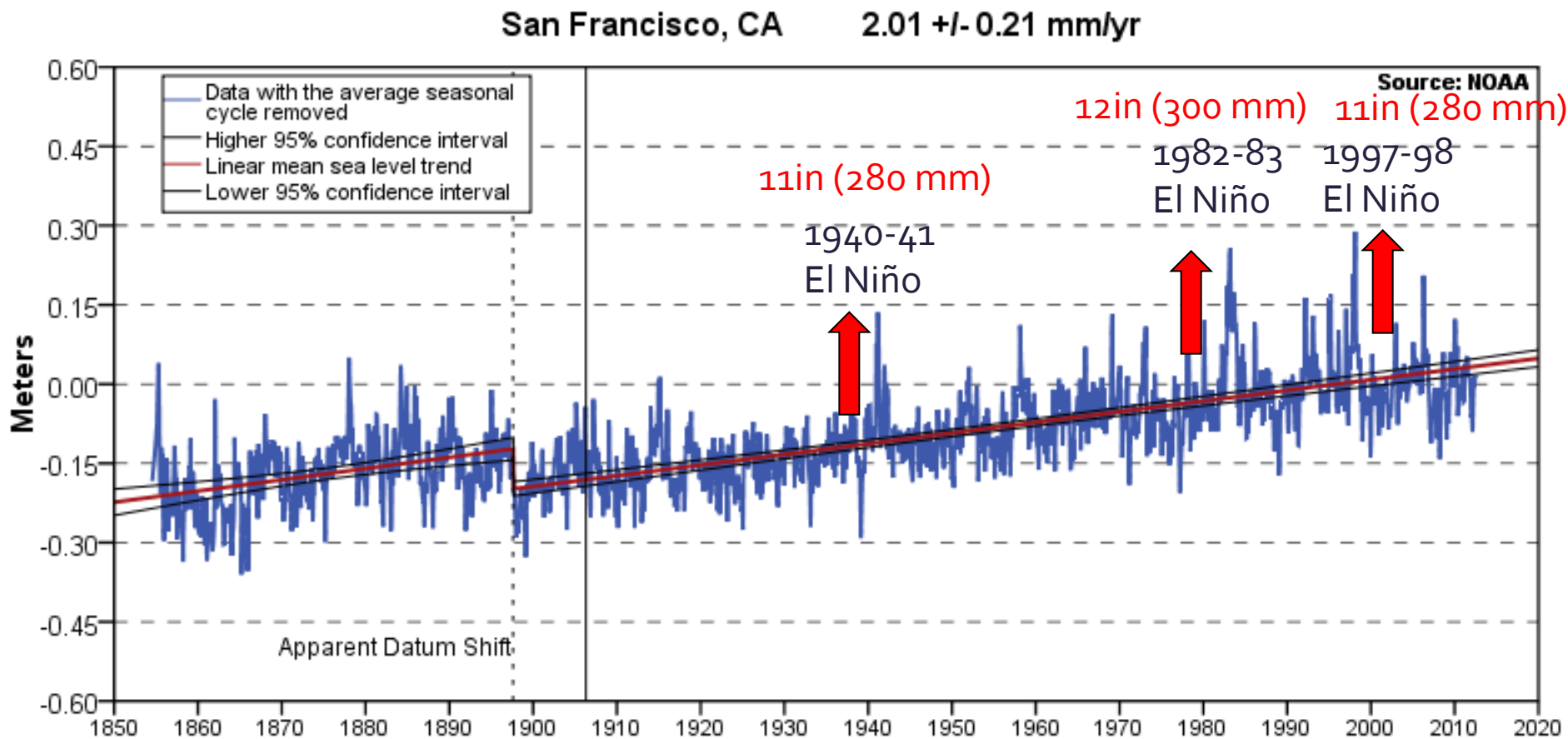


Landing in the water is not an acceptable long-term solution



California Recent Sea-Level Rise

Short-term events have had greater impacts than sea-level rise over the past century, and this will likely continue until at least 2050, except perhaps in very low lying areas.



ADAPTATION OR RESPONSES TO SEA-LEVEL RISE

North Carolina: Ignore Climate Change

After a state science commission predicted sea-level rise of up to 39 inches by 2100, business and development interests objected, complaining that the 39-inch projection would cost millions in regulations and restrict development. They came up with their own projections –

No more than an 8-inch rise by 2100

**WE DON'T GET TO VOTE
ON THE RATE OF SEA-LEVEL RISE**

SEA-LEVEL RISE IN VIRGINIA

from coastal scientists at Virginia Sea Grant



Virginia Legislature Responds to



Adapting to Sea Level Rise: A Guide for California's Coastal Communities

Nicole Russell
Gary Griggs
University of California Santa Cruz



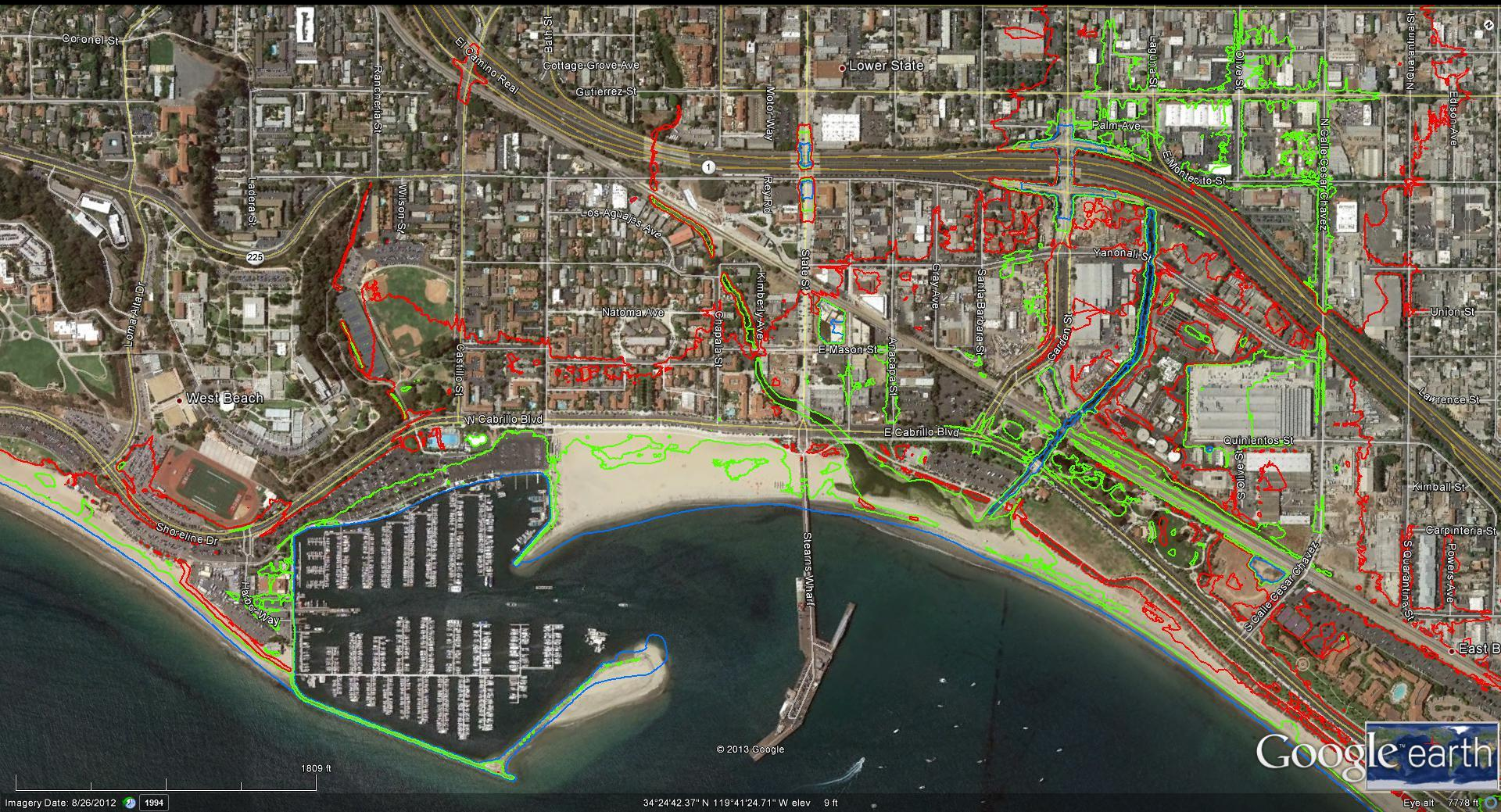
For the California Energy Commission
Public Interest Environmental Research Program
January 2012

A PROCESS TO PLAN FOR AND RESPOND TO SEA-LEVEL RISE

- 1. Conduct a sea-level rise vulnerability assessment for the community**
 - Evaluate historical vulnerability and damages
 - Project future sea-level rise
 - Assess exposure of community to sea-level rise hazards
 - Map vulnerability
- 2. Assess risk and adaptive capacity**
- 3. Develop an Adaptation Plan**
- 4. Implement the Plan**
- 5. Assess Plan on Regular Basis**

SEA-LEVEL RISE VULNERABILITY ASSESSMENT FOR CITY OF SANTA BARBARA

— PRESENT HIGH WATER — HIGH WATER + 24" SLR (2050) + 100 YEAR FLOOD
— HIGH WATER + 66" SLR (2100) + 100 YEAR FLOOD



WHICH SEA-LEVEL RISE VALUES TO USE ?

IMPORTANT CONSIDERATIONS:

1. Sea-level rise values from closest tide-gages combined with future projections (NRC Report and CO-CAT Guidance)
2. Projected lifespan of facility or project
3. Cost or value of replacement facility
4. The impact or consequence of damage to or loss of facility



We can't continue to fight the water

